

REMARKS

Favorable reconsideration is respectfully requested.

The claims are 1 to 12 and 14.

The above amendment is responsive to points set forth in the Official Action.

In this regard, it is now recited that the negative electrode is only surface fluorinated in main claim 1.

Claim 13 has been canceled to be consistent with claim 1.

Claim 14 recites thickness of the fluorinated surface layer and is now dependent on claim 1.

The significance of these amendments will become further apparent from the remarks below.

Claims 1 to 8 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (U.S. 5,599,640) in view of Sawa et al. (U.S. 6,030,724).

Further, claim 9 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. in view of Sawa et al. as applied to claims 1 to 8 and 10 above, and further in view of Narayanan et al. (U.S. 6,485,851).

Lastly, claims 11 to 14 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. in view of Sawa et al. as applied to claims 1 to 8 and 10 above, and further in view of Wang et al. (*J. Alloys and Compounds*, 1999).

These rejections are respectfully traversed.

In response to the first Official Action, main claim 1 was amended to recite that the alloy forming the negative electrode of the claimed fuel cell is a fluorinated hydrogen-absorbing alloy. It is now recited that such fluorination occurs on the surface, i.e. the alloy is surface fluorinated.

Turning to the rejection of claims 1 to 8 and 10 under 35 U.S.C. 103(a) over Lee et al. in view of Sawa et al., in connection with the fluorination of the electrode alloy, the rejection contends that Sawa et al. is directed to a hydrogen storage alloy and a secondary battery using the same and further points out that the reference teaches that the alloy may be subjected to a fluorinating treatment.

This position is apparently based on a failure to appreciate the nature of the processes proceeding on the electrodes of a secondary battery (Sawa et al.) and a fuel cell (present invention).

As described in ABSTRACT of Sawa, Sawa provides a secondary battery with an electrode of a hydrogen-storage alloy improved in relation to prevention of comminution, leading to elongation of the service life and the expansion of capacity.

The phenomenon of comminution of the hydrogen storage alloy is a consequence of absorption and releasing of hydrogen gas in and out of the hydrogen storage alloy forming the electrode.

As described in col. 4, lines 17 et seq. of Sawa, further improvements in this regard may be obtained by subjecting the alloy to a variety of treatments including plating with Cu or Ni, fluorination, nitridation, carbonization, boridation and alkalization.

In contrast, problems due e.g. to comminution or deterioration of the electrode-forming alloy are never encountered in the negative electrode formed from a hydrogen absorbing alloy due to very different mechanisms involved in the electromechanical reactions taking place on the electrode surface. Namely, the process in the fuel cell utilizes the catalytic activity of the electrode surface.

Since the mechanism involved is a surface phenomenon only, the negative

electrode of the fuel cell never suffers the problems of comminution or deterioration due to the absorption and releasing of hydrogen gas in and out of the body of the electrode.

The rejection apparently fails to show a linking disclosure between the very different phenomena taking place, one, on the electrode surface of a fuel cell and, the other, in the body of the electrode of a secondary battery.

The preparative procedure for the hydrogen electrode of the present liquid fuel cell is described in detail in the Reference Examples ([0053], [0054]) of the present specification. As is understood therefrom, the fluorination treatment of a hydrogen-absorbing alloy is carried out by dipping the alloy in an aqueous solution of an alkali fluoride.

It is therefore clear that the fluorination of the alloy takes place only on the surface, leaving the body of the alloy unfluorinated. In other words, there is no need to fluorinate the body of the alloy electrode because the improvement obtained by fluorination of the alloy is related to a surface phenomenon, as discussed above.

In fact, as described in Examples 1 and 2 of the present specification, remarkable improvements can be obtained by the surface fluorination of the alloy electrode in the performance of the liquid fuel cell constructed with the surface-fluorinated electrode.

Example 1 discloses that the discharge current in the fuel cell with the fluorinated hydrogen electrode was 180 mA while the value in a fuel cell with an unfluorinated electrode was only 80 mA (see [0060]). Further, Figure 3 graphically depicts the current-voltage characteristics of liquid fuel cells with fluorinated and unfluorinated hydrogen electrodes.

As is clear from the graph, substantial improvements can be obtained over the whole range by the fluorination of the alloy (solid line curve) as compared with an

unfluorinated electrode (broken line curve).

All of these facts support the unobviousness of the claimed invention over the cited references, alone or combined.

In the absence of a need to improve the negative electrode of a fuel cell with respect to comminution and deterioration, which are serious problems in a secondary battery, no one informed of the disclosure in Sawa relative to fluorination, among other treatments for this purpose in secondary batteries, would be motivated to employ a fluorinated negative electrode in his fuel cells, even if he were desirous of improving the catalytic activity of the electrode surface, without the benefit of the Applicant's disclosure. Again, fuel cells do not suffer from the problems of comminution and deterioration for reasons set forth above.

For the foregoing reasons, it is apparent that the rejections on prior art are untenable and should be withdrawn.


No further issues remaining, allowance of this application is respectfully requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact undersigned at the telephone number below.

Respectfully submitted,

Seijirau SUDA

THE COMMISSIONER IS AUTHORIZED
TO CHARGE ANY DEFICIENCY IN THE
FEE FOR THIS PAPER TO DEPOSIT
ACCOUNT NO. 23-0975.

By: 
Matthew M. Jacob
Registration No. 25,154
Attorney for Applicant

MJ/kes
Washington, D.C. 20006-1021
Telephone (202) 721-8200
Facsimile (202) 721-8250
November 15, 2004